

METHOD TO CONFIGURE AND QUOTE COMPONENT ARRAYS

FIELD OF INVENTION :

This invention relates to arrays of components including auto and airplane assemblies, equipment, harnesses, and particularly to a real time apparatus that configures and quotes items on the internet using inputs from users in a graphic user interface to design and develop drawings, schematics, costs, bills of material for arrays of components and particularly cable assemblies.

BACKGROUND AND INFORMATION DISCLOSURE

As modern systems related to manufacturing in many areas (e.g., telecommunications, power, etc.) become more complex, greater reliance must be placed on computer based methods to perform the tasks of system design and related procurement programs.

A number of disclosures have been described indicating the demand to meet this need.

For example, U.S. Patent 6,006,216 to Griffin discloses logical data architecture for fetch intensive data base applications including a first and second logical data base. The second data base includes materialized views over the first database. In preferred embodiments, the first data base is optimized for up date transactions and the second database is optimized for read transaction.

U.S. Patent 5,138,698 to Aldrich et al discloses a method and apparatus for aiding the design of assemblies on CADAM. The purpose of the invention is to create a 3 dimensional representation of the cable assembly. A three dimensional view of the model is then selected and transferred to a two dimensional representation while

retaining the aspect ratios of the cable assembly. Overall lengths of the cable selections aligned with the corresponding cable sections themselves are provided in human readable form.

U.S. Patent 4,757,461 to Stohr et al discloses a method for storing data defining the work piece and tool as well as the program data defining relative movements that are used to generate polygons which represent the work piece. Stohr's apparatus is for the design and development of a three dimensional view of a part on a single computer.

SUMMARY OF THE INVENTION:

It is an object of this invention to enable a user to design a an array of components where the array relates to any one of a number of industries, including telecommunications, power, automotive, airplanes, etc.

The method of this invention is particularly adaptable to the telecommunications industry. Typical projects involve construction of networks of connectors including

network options presented as drawings together with a bill of materials that lists sources, prices and delivery dates.

It is a further object of this invention to go beyond the present state of the art by:
providing access to the application program of this invention through the internet;
wherein the user is a client on the Internet communicating with the application program of this invention stored on the web server.

This invention is directed toward a software system residing on the Internet wherein the client (user) is enabled to:

design component assemblies such as the connectors and conductors of a network assembly;

configure and quote any number of options with any number of combinations.

address the material aspects of the assembly including obtaining purchase data of components;

calculate performance data.

The software program (herein after "program") of this invention residing in the web server allows a client to take up to 16.7 million items by 16.7 million options. The upper limit can be changed by the client if needed. The invention presents, using a GUI display through the browser of choice, the design of the assembly of

components. For example, in cable assemblies, data related to the harness, power cords and any current and data transferring component.

BRIEF DESCRIPTION OF THE FIG.

Fig. 1 is a flowchart of the base program of the method of this invention.

Fig. 2 is a flowchart of the program of fig. 1 modified for installation on a computer.

Fig. 3 is an Internet system for practicing the invention on the internet.

Fig. 4 is the program of this invention modified for adaptation to the internet.

DESCRIPTION OF PREFERRED EMBODIMENTS:

In the following paragraphs, there is presented what is presently believed to be an example of the best mode for carrying out the invention. The example is application of the invention to designing a cable network where the components are cable connectors interrelating to one another through conductors.

Turning now to a discussion of the drawings, fig. 1 is a flow chart listing the steps in carrying out the invention which is a method for generating a drawing of a network of at least one component and a plurality of interconnects.

In step 1 a schematic representation of the network is composed showing the components linked together by interconnects.

In step 2, a list of available components is compiled including part name, vendor source, current capacity.

In step 3, component variables are listed wherein each component variable represents one of the network components, respectively;

In step 4, each component is matched with a vendor part number determined by matching anticipated performance in the network component with listed performance of an available component.

In step 5, each component variable is assigned a component value wherein each component value is at least one of:

- component coordinates defining location of said network component;
- component type;
- vendor part number;
- anticipated performance value of said network component, respectively;

In step 6, a list of interconnect variables is compiled wherein each interconnect variable represents an interconnect connecting one of said network components to another one of said network components;

In step 7, at least one interconnect value of a set interconnect values is assigned to each interconnect variable, each interconnect value corresponding to one of:

- anticipated length of said respective interconnect;
- current anticipated in said interconnect;
- wire gage of said interconnect;
- type of said interconnect;

In step 8, a drawing of the network is created representing relative locations of network components and interconnects connecting said network components wherein each network component is labeled by a respective one of the component variables and each interconnect is labeled by a respective one of the interconnect variables.

In one embodiment, the program of fig. 1 is modified for installation into a self contained computer system which provides an in-house operation. Fig. 2 is a list of instructions compiled by modifying the flow chart of fig. 1 for adaptation to a program installed in a computer.

The computer program includes:

A. a table of component variables, each component variable corresponding to one of the network components, respectively. Each network variable is a list of values,

The list of values includes at least any one of a network component identification number, an anticipated load supported by the component and coordinates specifying location of the network component .

B. a table of available components includes a part number and specifications for each available component;

C. an instruction to display on a monitor of the computer an instruction to select, from the table of available components, those part numbers of available components having specifications matching specifications of said network components and store those selected part numbers as said values of variables in said table of network components;

D a table of interconnect variables, each interconnect variable corresponding to one of the network interconnects, respectively. Each interconnect variable includes a list of values. The list of values includes at least one of a network interconnect identification number, an anticipated load supported by the network interconnect, and network components to which the network interconnect is connected ;

E. a table of available interconnects listing type number and parameters of each available interconnect;

F. an instruction to display the table of available interconnects and the table of network interconnects for display on the monitor of the computer;

G. an instruction for display on the monitor an instruction to select from the table of available interconnects, those available interconnects having specifications matching specifications of the network interconnects and adding type numbers of selected available interconnects to the table of network interconnects;

an instruction to display the table of network components and the table of network components on the monitor of the computer;

H an instruction to calculate a length of each network conductor from the locations of respective network connectors and storing said calculated length with said type and parameters of said respective network conductor in the table of network conductors;

I. a configure module arranged to apply the location data of each network component and length calculated for each network interconnect to generate a representation of a drawing of the network;

J. an instruction to generate a drawing of the network for display on a monitor of the computer.

Fig. 3 shows another embodiment of the invention in which the program is adapted to an internet system. There are shown a client computer 12 with a monitor 13 and a printer 15. A browser program 17 is installed in the client computer 12. A service provider 14 communicates with both the client computer 12 and a server computer 16 (hereinafter "server") using any of the well known languages/protocols, e.g., (but not limited to) html language and http protocol. The network configuration program 18 of this invention resides in the server 16. The objective of the user of the client computer 12 is to generate a complete document defining a network of connectors and conductors. The document includes a formal (engineering) drawing, parts list, list of materials summarizing cost and schedule. The starting point of the project is an informal schematic drawing of the network..

Fig. 4 shows a flowchart of the steps of the method for generating the document according to the invention adapted for use on the Internet utilizing the system of Fig. 3. According to this version, a client, accessible to a client computer, is enabled to communicate with a server computer to generate a drawing of a network of at least one interconnect and a plurality of components.

In step 1, a server computer is connected to an internet provider connected to the client computer:

In step 2, a browser program is installed in the client computer for communication with the server computer;

In step 3, a program is installed on the server computer which includes:

a table of component variables, each component variable corresponding to one of the network components, respectively, each the network variable is a list of values, the list of values including at least one of a network component identification number, an anticipated load supported by the component, coordinates specifying location of the network component;

a table of interconnect variables, each interconnect variable corresponding to one of the network interconnectors, respectively, each interconnect variable including a list of values, the list of values including at least one of a network interconnect identification number, an anticipated load performance, network components to which the network interconnect is connected ;

H an instruction to calculate a length of each network conductor from the locations of respective network connectors and storing said calculated length with said type and parameters of said respective network conductor in the table of network conductors;

I. a configure module arranged to apply the location data of each network component and length calculated for each network interconnect to generate a representation of a drawing of the network;

J. an instruction to generate a drawing of the network for display on a monitor of the computer.

Fig. 3 shows another embodiment of the invention in which the program is adapted to an internet system. There are shown a client computer 12 with a monitor 13 and a printer 15. A browser program 17 is installed in the client computer 12. A service provider 14 communicates with both the client computer 12 and a server computer 16 (hereinafter "server") using any of the well known languages/protocols, e.g., (but not limited to) html language and http protocol. The network configuration program 18 of this invention resides in the server 16. The objective of the user of the client computer 12 is to generate a complete document defining a network of connectors and conductors. The document includes a formal (engineering) drawing, parts list, list of materials summarizing cost and schedule. The starting point of the project is an informal schematic drawing of the network..

a table of available interconnects listing type number and parameters of each available interconnect;

a table of available components including a part number and specifications for each available component;

an instruction to transmit, to the browser, the table of available components and the table of network components;

an instruction for transmission to the browser to display on the client computer an instruction to select from the table of available component part numbers, available components having specifications matching specifications, an instruction to transmit, to the browser, the table of available interconnects and the table of network interconnects for display on the client computer;

an instruction, for display to the client, an instruction directing the client to select from the table of available interconnects, those available interconnects having specifications matching specifications of the network interconnects and adding type numbers of selected available interconnects to said table of network interconnects;

an instruction to the browser to transmit the table of network interconnects and table of network components from the client computer back to the server computer;

an instruction to calculate a length of each network interconnect from the location of respective network components and storing the calculated length with the type and parameters of the respective network interconnect in the table of network interconnects;

a configure module arranged to apply the location data of each network connector and length calculated for each network conductor to generate a representation of a drawing of the network;

an instruction transmitting the representation of a drawing to the browser whereby the browser generates a drawing of the network for display on a monitor of the client computer.

In step 4. an instruction to initiate the program is transmitted from the client computer through the browser to the server computer.

In step 5, the client adds selected part numbers of available components and type numbers of available interconnects to the tables of network components and interconnects respectively in response to prompt displayed by the client computer.

In step 6, in response to step 5, a drawing of the network is displayed by the client computer.

In step 7, a bill of materials is generated including a cost of the network determined by summing the cost of all of the components and interconnects.

Variations and modifications of the flow charts in figs. 1-4 may be introduced which are within the scope of the invention.

In applying the method of the invention to cable networks, the connectors are regarded as components, the conductors are regarded as interconnects between components.

In step 1 a schematic representation of the network is composed showing the conductors linked together by the connectors.

In step 2, a list of available conductors is compiled including part name, vendor source, current capacity.

In step 3, connector variables are listed wherein each connector variable represents one of the network connectors, respectively;

In step 4, each connector is matched with a vendor part number determined by matching anticipated current in the network connector with current capacity of an available connector.

In step 5, each connector variable is assigned a connector value wherein each connector value is at least one of:

- connector coordinates defining location of said network connector;
- connector type;

vendor part number;

anticipated current value through said network connector, respectively;

In step 6, a list of conductor variables is compiled wherein each conductor variable represents a conductor connecting one of said network connectors to another one of said network connectors;

In step 7, at least one conductor value of a set of conductor values is assigned to each conductor variable, each conductor value corresponding to one of:

anticipated length of said respective conductor;

current anticipated in said conductor;

wire gage of said conductor;

type of said conductor;

In step 8, a drawing of the network is created representing relative locations of network connectors and conductors connecting said network connectors wherein each network connector is labeled by a respective one of the connector variables and each conductor is labeled by a respective one of the conductor variables.

In one embodiment, the program of fig. 1 is modified for installation into a self contained computer system which provides an in-house operation. Fig. 2 is a list of instructions compiled by modifying the flow chart of fig. 1 for adaptation to a program installed in a computer.

The computer program includes:

A. a table of connector variables, each connector variable corresponding to one of said network connectors, respectively. Each network variable is a list of values, The list of values includes at least any one of a network connector identification number, an anticipated current load through said connector and coordinates specifying location of the network connector.

B. a table of available connectors includes a part number and specifications for each available connector;

C. an instruction to display on a monitor of the computer an instruction to select, from the table of available connectors, those part numbers of available connectors having specifications matching specifications of said network connectors and store those selected part numbers as said values of variables in said table of network connectors;

D a table of conductor variables, each conductor variable corresponding to one of the network conductors, respectively. Each conductor variable includes a list of values. The list of values includes at least one of a network conductor identification number, an anticipated current load through the network conductor, network connectors to which the network conductor is connected ;

E. a table of available conductors listing type number and parameters of each available conductor;

G. an instruction to display the table of available conductors and the table of network conductors for display on the monitor of the computer;

. an instruction for display on the monitor an instruction to select from the table of available conductors, those available conductors having specifications matching specifications of the network conductors and adding type numbers of selected available conductors to the table of network conductors;

H. an instruction to display the table of network conductors and the table of network connectors on the monitor of the computer;

. an instruction to calculate a length of each network conductor from the locations of respective network connectors and storing said calculated length with said type and parameters of said respective network conductor in the table of network conductors;

J a configure module arranged to apply the location data of each network connector and length calculated for each network conductor to generate a representation of a drawing of the network;

K. an instruction to generate a drawing of the network for display on a monitor of the computer.

Fig. 3 shows another embodiment of the invention, in which the program is adapted for an Internet system

There are shown a client computer with a monitor and printer. A browser program is installed in the client computer. A service provider communicates with both the client computer and a server computer (hereinafter "server") using any of the well known languages/protocols, e.g., (but not limited to) html language and http protocol. The network configuration program of this invention resides in the server. The objective of the user of the client computer is to generate a complete document defining a network of connectors and conductors. The document includes a formal (engineering) drawing, parts list, bill of materials summarizing cost and schedule.

The starting point of the project is an informal schematic drawing of the network.

Fig. 4 shows a flowchart of the steps of the method for generating the document according to the invention adapted for use on the Internet utilizing the system of Fig.

3. According to this version, a client, accessible to a client computer, is enabled to communicate with a server computer to generate a drawing of a network of at least one conductor and a plurality of connectors.

In step 1, a server computer is connected to an internet provider connected to the client computer:

In step 2, a browser program is installed in the client computer for communication with the server computer;

In step 3, a program is installed on the server computer which includes:

a table of connector variables, each connector variable corresponding to one of the network connectors, respectively, each the network variable is a list of values, the list of values including at least one of a network connector identification number, an anticipated current load through the connector, coordinates specifying location of the network connector;

a table of conductor variables, each conductor variable corresponding to one of the network conductors, respectively, each conductor variable including a list of values, the list of values including at least one of a network conductor identification number, an anticipated current load through the network conductor, network connectors to which the network conductor is connected ;

a table of available conductors listing type number and parameters of each available conductor;

a table of available connectors including a part number and specifications for each available connector;

an instruction to transmit, to the browser, the table of available connectors and the table of network connectors;

an instruction for transmission to the browser to display on the client computer an instruction to select from the table of available connectors part numbers of available connectors having specifications matching specifications an instruction to transmit,

to the browser, the table of available conductors and the table of network conductors for display on the client computer;

an instruction, for display to the client, an instruction directing the client to select from the table of available conductors, those available conductors having specifications matching specifications of the network conductors and adding type numbers of selected available conductors to said table of network conductors;

an instruction to the browser to transmit the table of network conductors and table of network connectors from the client computer back to the server computer;

an instruction to calculate a length of each network conductor from the location of respective network connectors and storing the calculated length with the type and parameters of the respective network conductor in the table of network conductors;

a configure module arranged to apply the location data of each network connector and length calculated for each network conductor to generate a representation of a drawing of the network;

an instruction transmitting the representation of a drawing to the browser whereby the browser generates a drawing of the network for display on a monitor of the client computer.

In step 4. an instruction to initiate the program is transmitted from the client computer through the browser to the server computer.

In step 5, the client adds selected part numbers of available connectors and type numbers of available conductors to the tables of network connectors and conductors respectively in response to prompt displayed by the client computer.

In step 6, in response to step 5, a drawing of the network is displayed by the client computer.

In step 7, a bill of materials is generated including a cost of the network determined by summing the cost of all of the connectors and conductors.

Application of the invention to a network of conductors and connectors can include the introduction of shielded cables. The operating frequency is selected as a conductor type requiring that operating frequency be selected as one of the values of the respective variables. Cost of shrink tubing may be added in computing a bill of materials and cost. Delivery dates may be included as part of the data enabling construction of a build schedule.

The following two examples applied to a network of conductors and connectors illustrate these and other variations of the invention.

EXAMPLE 1

A Network Assembly Design of Multiconductor Cables on the Web.

This browser window is to design a network cable assembly, harness, or some combination of both.

The user selects the number of connectors to be designed and linked together in the network assembly. for example, the user will select 3, (but any number can be selected.) A pull down menu asks the user for connector type, number of circuits, wire gages, temperature, and current. Special options are available for different levels of design guidance. A relational database selects the appropriate connectors. Connectors are listed with prices, supplier names and delivery times. A menu for connector detailed drawings is listed on the main menu bar. The user selects connector and a graphical representation depicting the connector is added to the drawing. The bill of materials is updated with the new connector. This process is repeated for the next two connectors. Off the tool bar is a wiring list which is a table corresponding to the number of connectors and the number of circuits within each connector. The user fills in the "from-t-" list on the table until it is complete. Notes and dimensions can be added in the tool bar. The user can add specific notes as needed and will be displayed in an area available on the drawing. The measurement system will allow the user to select either metric or U.S. Standard or both. On the dimensioning toolbar, the length for each tool bar is defined by starting points and end ending points. These lengths are displayed on the screen. Item numbers are automatically added for each connector and additional numbers can be added for other items such as shrink tubing, tie wraps, labels or other parts. Other parts such as switches or fuses are uploaded and added to the drawing. Other information is typed in manually such as part number and item description. The

company logo can be added along with proprietary warnings. Names of the drawers and Approvals can be added. The drawing can be downloaded to the customer computer data-base. Finally the drawing can be printed without any translators or other types of information. Part numbers and logos can be added to the drawing with a search function for both name and number.

EXAMPLE 2

A Coaxial or Fiber Optic Assembly:

The user selects the number of connectors to be designed and linked together in the coaxial assembly. For this example, the user will select two connectors, but any number can be selected.

A pull down menu asks the users:

select impedance (e.g., 50, 75, 93 ohms)

select frequency range for example:

D.C to 500 MHz,

D.C. to 2 GHz,

D.C. to 6 GHz,

D. C. to 12 GHz;

D.C. to 18 GHz;

D.C to 26 GHz;

D.C. to 40 GHz.

A dynamic graph gives the customer the cost vs. frequency chosen.

Then connector types are listed given the frequency and impedance type such as BNC, TNC, N, etc.

The client selects the connectors desired which includes subsets of the major category such as sex of the connector, and whether the connector is a bulkhead, right angle, female, flange, P.C. mount, etc. The client then selects the of circuits or branches desired. With the connector type known, the cable types are displayed e.g., RG-179 or .085 TP/AL Semi-rigid. Temperature and current is added in the notes section.

With this information, the search engine searches within the regional data base and selects the appropriate connectors. Connectors are listed with prices supplier names, part numbers, performance data and delivery times.

A menu for connector detailed drawings is listed in the main menu bar. The user selects a connector and a drawing depicting the connector is added to the cable assembly drawing. The Bill of material is updated with the new connector. This process is repeated for the next Connector. Off the tool bar is a schematic wiring list.

If more than two connectors are required, then the following questions are asked:

1. Is impedance balancing required?
2. Is the impedance required resistive or reactive?

A table corresponding to the number of connectors and the number of circuits within each connector. The user fills in the "from -to" list on the table until it is complete . Notes and dimensions can be added in the tool bar. Notes are subject to the user and will be displayed in an available area. Measurement system will allow the user to select either US Standard, metric or both.

On the dimensioning toolbar, the length from each connector is defined.

Calculation of insert ion loss is calculated within the toolbar using frequency data, connector data and cable data with its length. Return loss is also found under this toolbar along with VSWR (Voltage Standing Wave Ratio) conversion calculator. The lengths of the cables are displayed on the screen.

Item numbers are automatically added for each connector and additional numbers are added for each connector and additional numbers can be added for other items such as shrink tubing, tiewraps, labels or other parts. Special parts including switches and fuses are uploaded and added to the drawing. The part number and item description is typed in manually. Names of originators and approvals are added. The drawing can be downloaded to the customers data base.

Finally, the drawing is printed without translators or other types of information. After this, selection, the number of connector boxes appear on the screen.

After this selection, the connector is drawn on the screen along with the part number of the connectors.

The program of this invention is a complete enterprise wide software solution and includes:

- all aspects of purchasing with smart BOM (bill of materials) learning;
- all aspects of web presence including Configure and Quote TM,
- all aspects of shipping and receiving including interfacing to third party delivery services such as UPS;
- all aspects of order entry.

The internet program is a focused web solution for any sized business, By including with the powerful Configure and Quote TM SOFTWARE MODULE included in the program, the client is enabled to create arrays that have 16.7 million products by 16.7 million options with a secure shopping cart. All aspects of the system are dynamic and easy to up date and do not require "flat files".

The program is a major advance in large complex quoting of products. The software eliminates the need for flat files or static tables with links to carts. Delimiters become dynamic with the large array software.

Fiber optics are similar to coaxial cables with different variables for cable.

The website is empowered in new ways by allowing customers to configure their selections in any one of millions of ways and still keep them in a virtual cart.

In various embodiments:

1. the program creates part numbers by formulas that are set by the user, removing the need for flat files. The full version enables the user to run purchasing, shipping, web transactions, and status/tracking reports all from a single system.

2. the Configure and Quote module allows the user to create quote arrays that have 16.7 products by 16.7 options with a secure shopping cart. All aspects of the system are dynamic and easy to update.

The program's front end is presented in XHTML. (Extensible Hyper Text Mark-up Language). Therefore only simple knowledge of a web browser is required to operate it. In addition, writing in XHTML enables the program to be accessed via the wireless web in the very near future.

The program is highly modulated when DOD software standards are applied so that the program is highly configurable. Therefore, new users may make changes via simple menus whereas more advanced users may manually edit the configuration files to make more advanced or radical changes.

When written in PHP (PHP Hyper text Preprocessor), the program is highly scalable when written in PHP. It will run on a 386 or a higher end SMP server, is cross platform to Linux or any other Unix platform as well as Windows NT. The program has the ability to handle as much data as the database below it.

Programs written in PHP run on a large number of platforms and can interface with many databases. PHP's high speed, most diverse data base connectivity, ease of customization, and cross platform capability makes it an ideal language for this application.

In one embodiment, the program is written in modular form to single input/output section a that comply with DOD standards. All inputs and outputs are audited for correctness by comparing against regular expressions and matching a string against a pattern. This acts as a filter against bad inputs and outputs and protects against "buffer overflow and piping" (unauthorized integration of programs by an external user). This security ensures that the program will not pass sensitive data to the user. The program is secure after a defaults installation.

The foregoing examples and descriptions illustrate the application of the invention to a wide variety of manufacturing and assembly projects. In the applications cited, the components are connectors and the interconnects are conductors of a network.

In another application, the project is an electrical system for a building and the components are the furnace, lights, airconditioning, refrigeration and the interconnects comprise the wiring of the building.

In another application, the project is a LOCAL AREA NETWORK. The components are computers and the interconnects are the connecting cables.

Other variations may be considered within the scope of the invention. I therefore wish to define the scope of my invention by the appended claims.